

REMARKS

In the Office action mailed January 20, 2004, claims 93-96, 100 and 101 were rejected under 35 USC §102(e) as being anticipated by Mayer et al. (6,315,883) and under 35 USC §103(a) as being unpatentable over Mayer et al.

Applicants address concerns of the Examiner. Independent claim 93 is amended to include features of claim 94. Claim 94 is canceled. Claims 93, 95, 96, 100, and 101 are pending.

§102

Claims 93-96, 100 and 101 are rejected under 35 USC §102 as anticipated by Mayer et al.

The present invention provides a novel planar conductive material structure usable in manufacturing an interconnect for an integrated circuit. As amended, claim 93 is indicative of an independent claim and recites:

...
a substrate having a top portion that includes a surface portion and a cavity portion, wherein the cavity portion has at least a first cavity having a width of less than one micron and a second cavity having a width larger than 10 microns; and

a planar conductive layer that is formed within the cavity portion and on the surface portion such that a predetermined thickness range of the planar conductive layer over the surface portion is between one tenth and one half of the thickness of the planar conductive layer within the cavity portion.

The Office action indicates that Mayer et al. disclose cavity features may have an aspect ratio of greater than 3:1 and metallization thickness of one half feature width is needed to close the cleft over the feature. Combining the two expressions, the Office action asserts that Mayer et al. teach that the thickness of the metallization over the surface portion is one sixth of the thickness within the cavity portion (width of cavity = 1/3 depth of cavity; metallization on surface = 1/2 of metallization in cavity, i.e. depth of cavity; thus, thickness of metallization on surface = 1/6 of thickness of metallization in cavity). One sixth falls within the range of one tenth and one half recited in instant claim 93. Thus, the Office action concludes that Mayer et al. disclose all the features recited in claim 93.

Applicants respectively traverse the conclusion that Mayer et al. disclose all the features recited in claim 93. Specifically, claim 93 recites a substrate having a top portion that includes a surface portion and a cavity portion, wherein the cavity portion has at least a first cavity having a width of less than one micron and a second cavity having a width larger than 10 microns. The Office action improperly combined the two expressions to describe, in particular low aspect features. Mayer et al. disclose that electroplating of high aspect ratio features (i.e. depth to

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width>3:1) are rapidly filled, and the metal above them becomes rapidly planarized. Typically a metallization thickness of ½ the feature is needed to close the cleft over the feature. Further addition of metal reduces the size of the cleft above the feature. Surfaces in which sufficient metal to fill and produce small clefts above high aspect ratio features will fill low aspect ratio features, but the latter features (i.e. low aspect ratio features) exhibit large recesses in the filled profile equal to the original feature depth (see FIG. 3) which are very difficult to planarize using conventional electropolishing technology. Emphasis and italicized supplied (see col. 2, lines 26-40). Accordingly and contrary to the assertion of the Office action, Mayer et al. identify limitations of the current art to fill low aspect ratio features. Moreover, the calculation of Mayer et al. would not hold for the case of large cavities, because the width of the large cavities is not a fraction of the cavity depth but in fact, is much larger than the cavity depth. Applicants submit that Mayer et al. do not show the recitation of claim 93.

As amended, independent claim 93 further distinguishes Mayer et al. Claim 93 recites that the cavity portion has at least a first cavity having a width of less than one micron and a second cavity having a width larger than 10 microns, and a planar conductive layer that is formed within the cavity portion and on the surface portion such that a predetermined thickness range of the planar conductive layer over the surface portion is between one tenth and one half of the thickness of the planar conductive layer within the cavity portion. Mayer et al. do not show or suggest the recitation of claim 93. Accordingly, applicants respectfully request that the rejection to independent claim 93 be withdrawn.

For the above reasons, applicants submit that the pending claims recite at least one feature not taught or suggested by the references. Consequently, applicants submit that the pending claims are allowable over the references. Applicants therefore request that the Examiner reconsider and withdraw the §102 rejections.

§103

Claims 93-96, 100 and 101 were rejected under §103 as being unpatentable over Mayer et al. Under the Graham test, three factors must be evaluated: the scope and content of the prior art; the differences between the prior art and the claimed invention; and the level or ordinary skill in the art. (MPEP 706 and 2141 et seq.).

Applicants respectively traverse the §103 rejection. In the background, Mayer et al. described a problem with the current art and disclosed that the typical metallization thickness applies only to high aspect ratio features. Low aspect ratio features are not applicable. Typically, a metallization thickness of ½ the feature width is needed to close the cleft over the feature. Further addition of metal reduces the size of the cleft above the feature. Surfaces in which sufficient metal to fill and produce small clefts above high aspect ratio features will fill low aspect ratio features, but the latter features exhibit large recesses in the filled profile equal to the original feature depth (see FIG. 3) which are very difficult to planarize using conventional electropolishing technology. Emphasis supplied (see col. 2, lines 32-39)

Mayer et al. do not teach or suggest the claim 93 recitation that the cavity portion has at least a first cavity having a width of less than one micron and a second cavity having a width larger than 10 microns, and a planar conductive layer that is formed within the cavity portion and on the surface portion such that a predetermined thickness range of the planar conductive layer over the surface portion is between one tenth and one half of the thickness of the planar conductive layer within the cavity portion. On the contrary, Mayer et al. define a problem that the current invention solves.

Skill in the art does not provide the difference between the reference and the claimed invention. An engineer skilled in the art would not develop the claimed invention with the Mayer et al. reference and skill in the art. Accordingly, claim 93 is patentable over Mayer et al. Applicants respectively request that the §103 rejection to claim 93 be withdrawn.

Applicants submit that since the independent claim 93 is not taught or suggested by the references, that the dependent claims are also allowable over the references. Accordingly, applicants respectively request that the 35 USC §103(a) rejection be withdrawn and that the claims be allowed.

Claim 95 depends on claim independent claim 93 and is patentable by its dependence on claim 93. Claim 95 further recites that the top portion includes an insulator layer and a barrier layer overlying said insulator layer and wherein the cavities are formed in the insulator layer.

Claim 96 depends on claim independent claim 93 and is patentable by its dependence on claim 93. Claim 95 further recites that the planar conductive material comprises copper or copper alloy.

Claim 100 depends on claim independent claim 93 and is patentable by its dependence on claim 93. Claim 95 further recites that an integrated circuit including the structure of claim 93.

Claim 101 depends on claim independent claim 93 and is patentable by its dependence on claim 93. Claim 95 further recites that the planar conductive material comprises copper.

Conclusion

Applicants have addressed the concerns of the Examiner in pointing out and distinguishing the present invention with the prior art. Claim 93 is amended to more particularly point out and distinctly claim the subject matter which the applicants regard as the invention. Claims 93, 95, 96, 100, and 101 are patentable over the art of record. For these reasons, applicants respectfully request that the Examiner reconsiders and withdraws the rejections of the claims and allows the application. Accordingly, it is respectfully requested that the claims be allowed.

If any matters can be resolved by telephone, applicants request that the Patent and Trademark Office calls the applicants at the telephone number listed below.

Respectfully submitted,

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